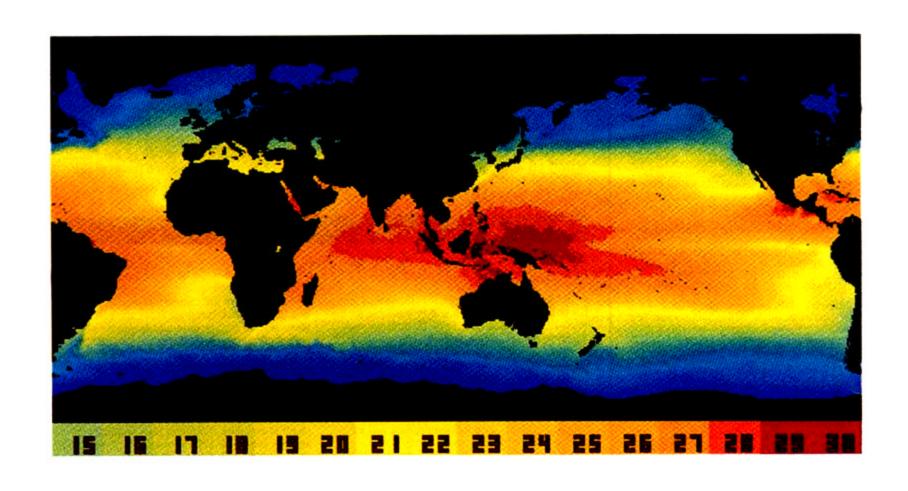
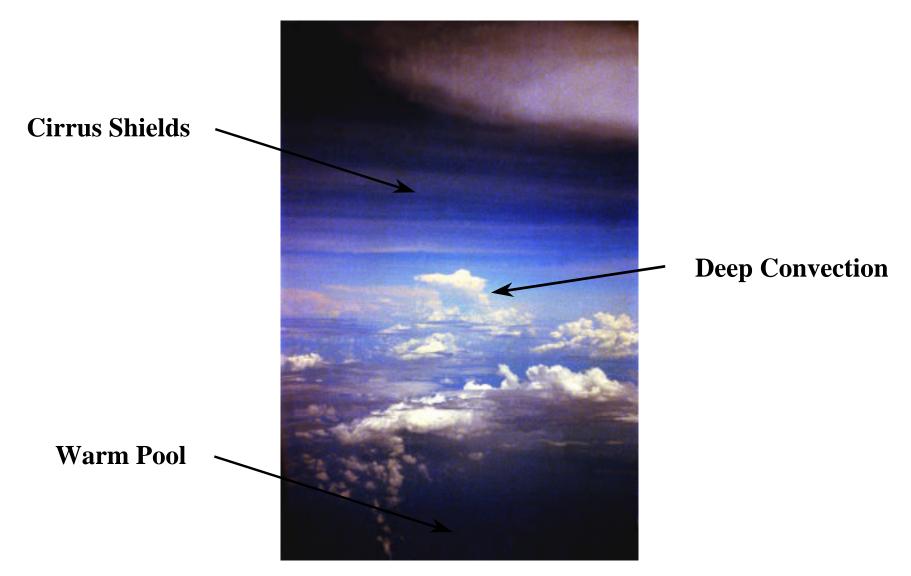
# Tropical Western Pacific Infrastructure and Science -Bill Porch

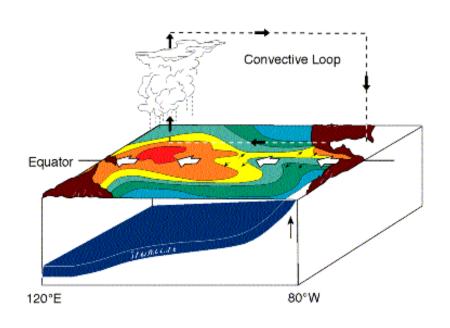
### Pacific Warm Pool

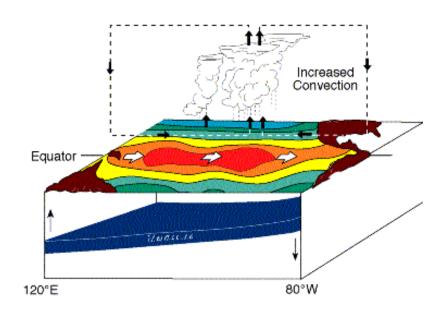


# **Deep Convection**



### El Niño Southern Oscillation



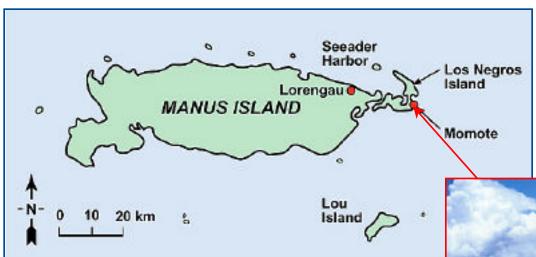


**Normal Conditions** 

El Niño Conditions

Source: www.pmel.noaa.gov/toga-tao/el-nino-story.html

## TWP Site 1: Manus (ARCS-1)

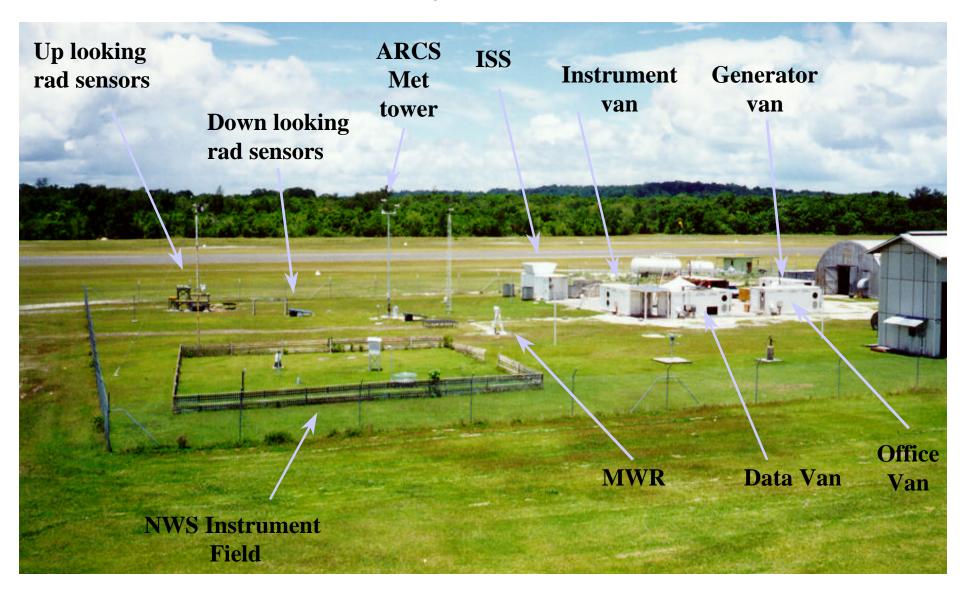


- Began operations in 1996
- Collaboration with Papua New Guinea National Weather Service (NWS)

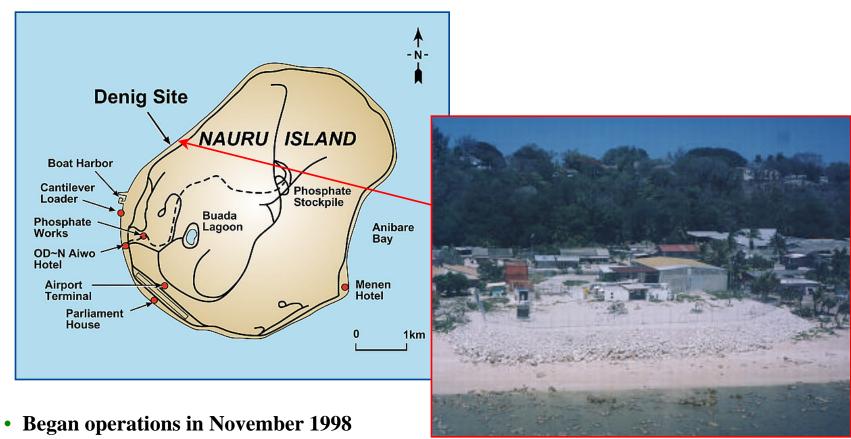


ARCS-1 at Momote Airport, Papua New Guinea

# Instrument Layout at ARCS-1



# TWP Site 2: Nauru (ARCS-2)



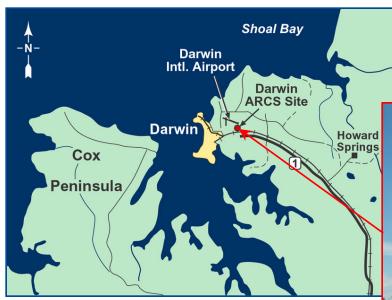
- Collaboration with Nauru Department of **Environment and Development (DED)**

ARCS-2 in Denig, Republic of Nauru

# Nauru Island



## TWP Site 3: Darwin (ARCS-3)



- Began operations in April 2002
- Collaboration with Australian Bureau of Meteorology
- Maintenance center for all three ARCS sites



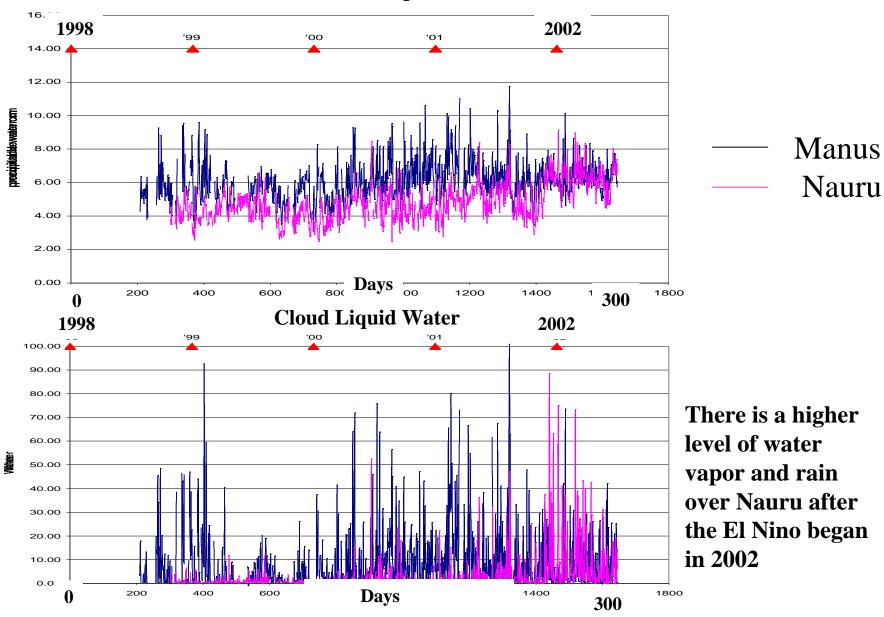
ARCS-3 at Darwin Airport, Darwin, Northern Territory, Australia

# Nauru Site Opening

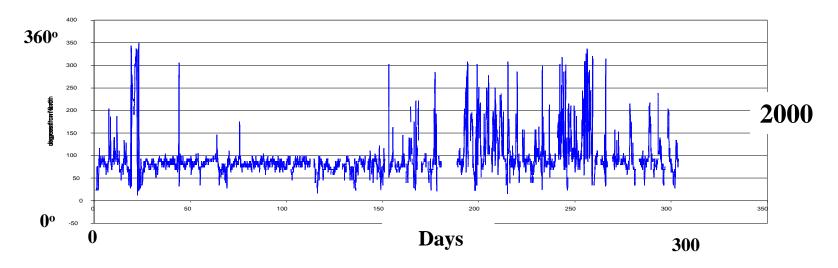


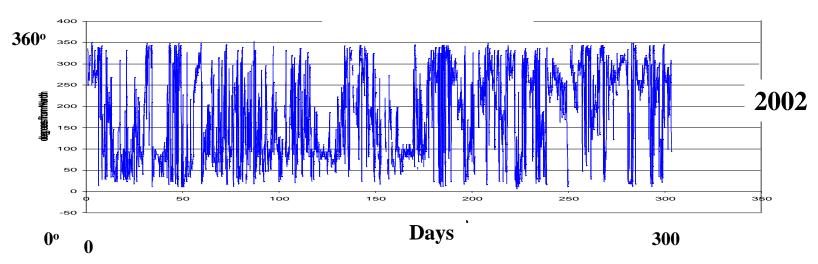
The Nauru Site officially began its operations with the opening ceremony on 20 November 1998. Dr. Wanda Ferrell, DOE/OBER, and His Excellency Derog Gioura, acting president of Nauru, released two connected weather balloons symbolizing the joint effort of ARM and Nauru in establishing and operating the site.





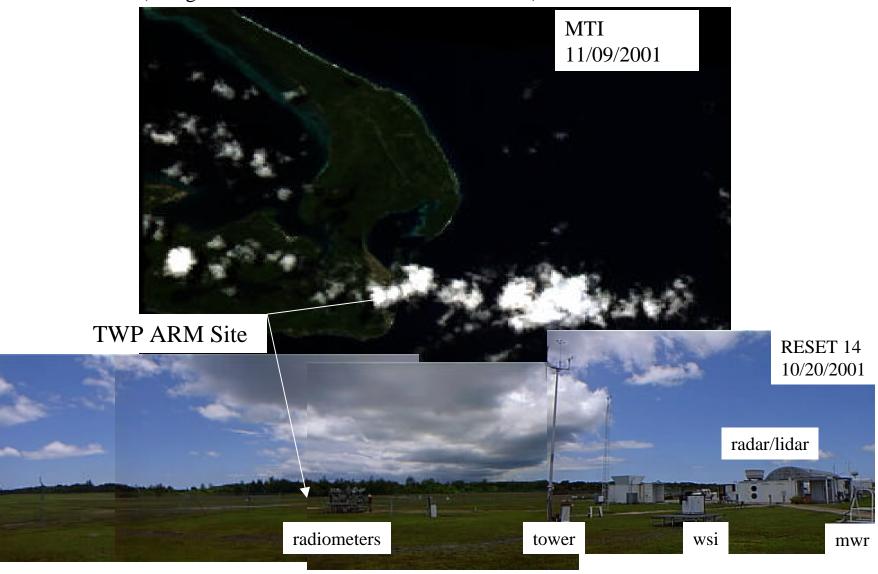
### Wind Direction Nauru





There are more easterly winds during El Nino year

Fig. 2. Island clouds do affect radiation measurements on Manus, Papua New Guinea (though less often than on the island of Nauru).



Manus Island Cloud Trails

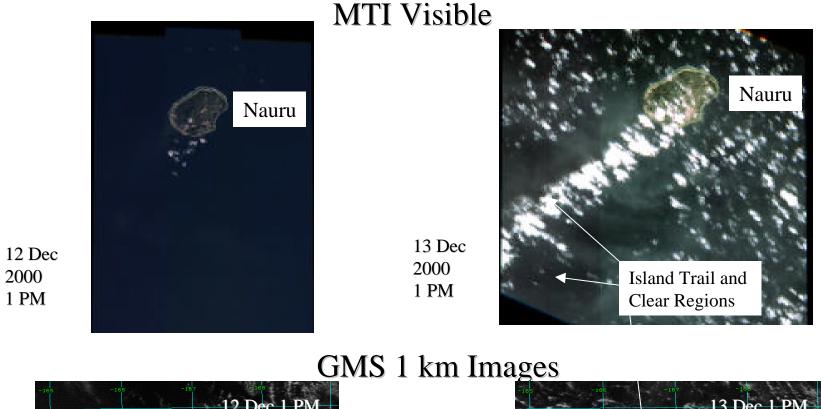
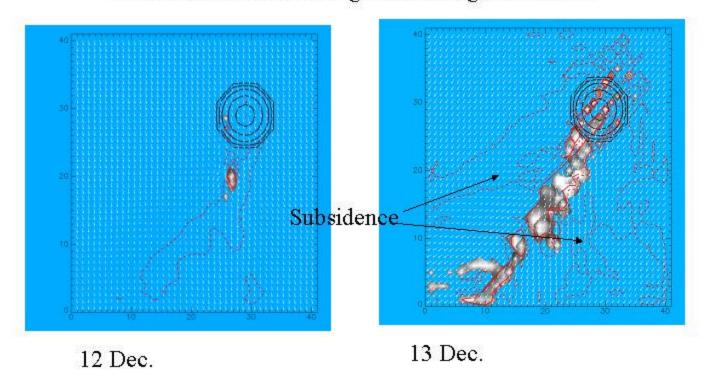




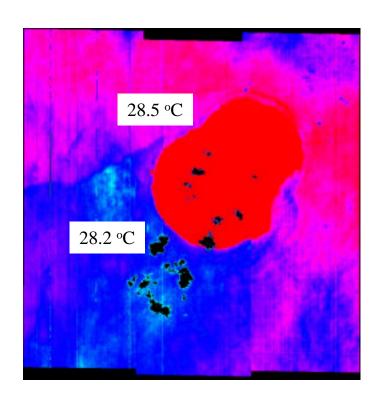
Fig. 1 Comparison of DOE Multispectral Thermal Imagaing Satellite and GMS 1km resolution images on 12 Dec. (no island cloud trail) and 13 Dec. (fully developed island cloud trail).

### Model Calculations Using Meteorological Profiles



RAMS model calculations using Rawinsonde profiles on 12 Dec. (no cloud trail) and On 13 Dec. 2000 (with fully developed island cloud trail.

### MTI Water Temperatures



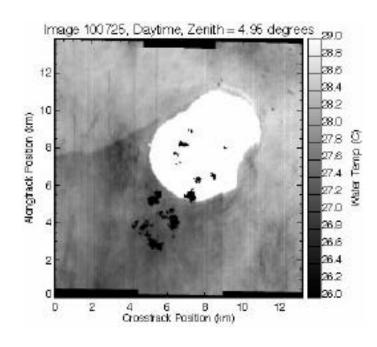
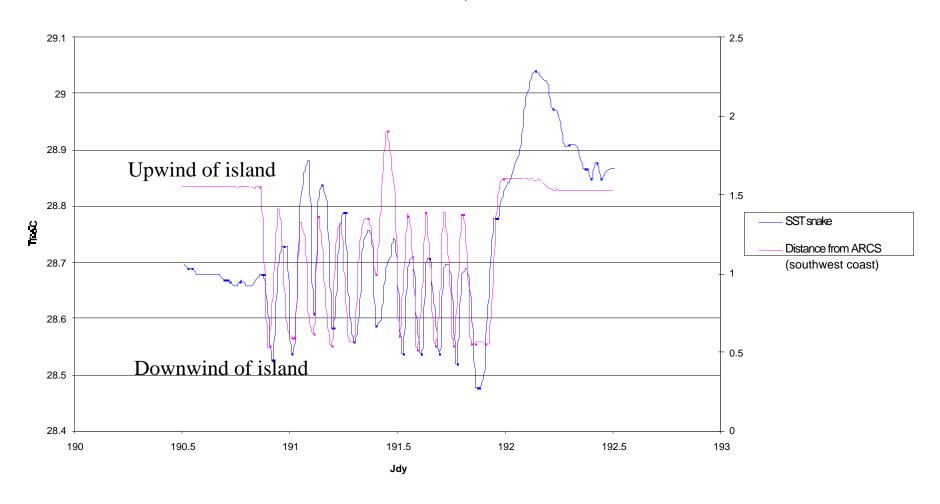
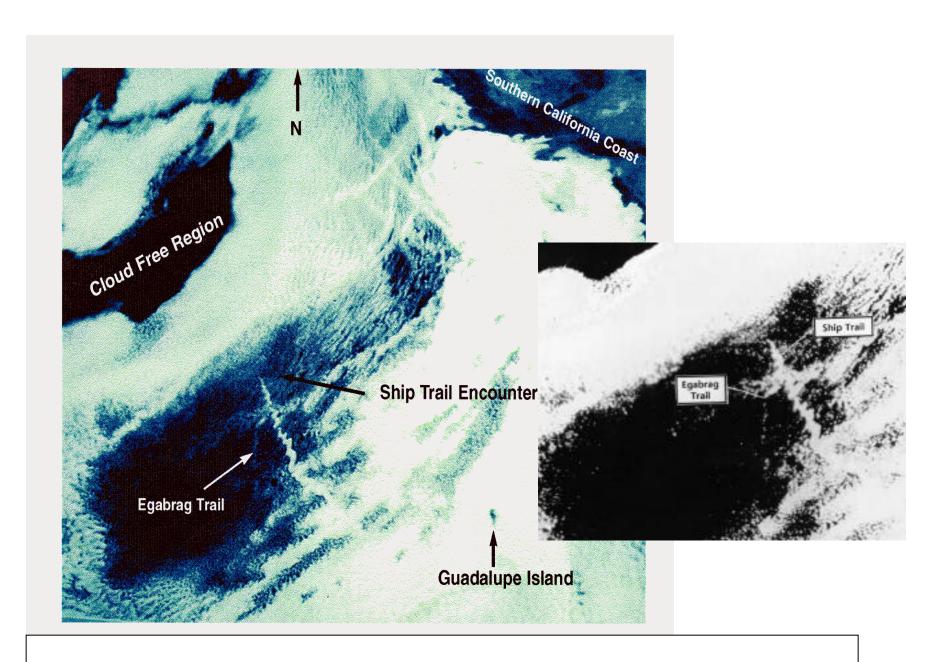


Fig. 3. The MTI derived Surface Water Temperature appears to be about 0.3 °C warmer upwind of the Island

### Island SST compare 7/11/99

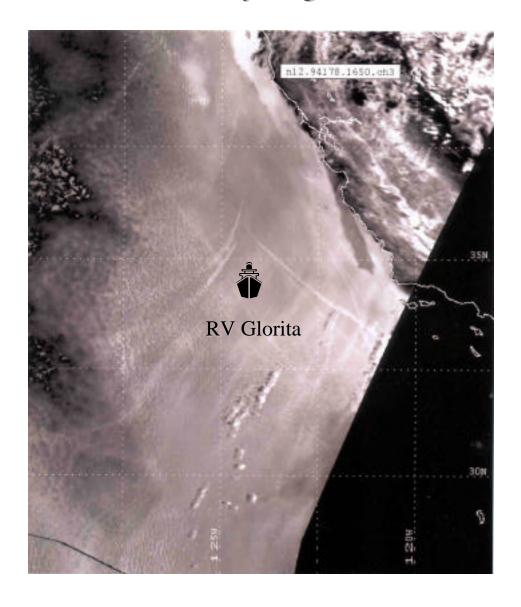


During Nauru 99 experiment research ship circled island day and night making Sea Surface Temperature Measurements (blue °C). Distance of the ship from ARCs site (pink) shows highest temperatures upwind of island or farthest from ARCs.



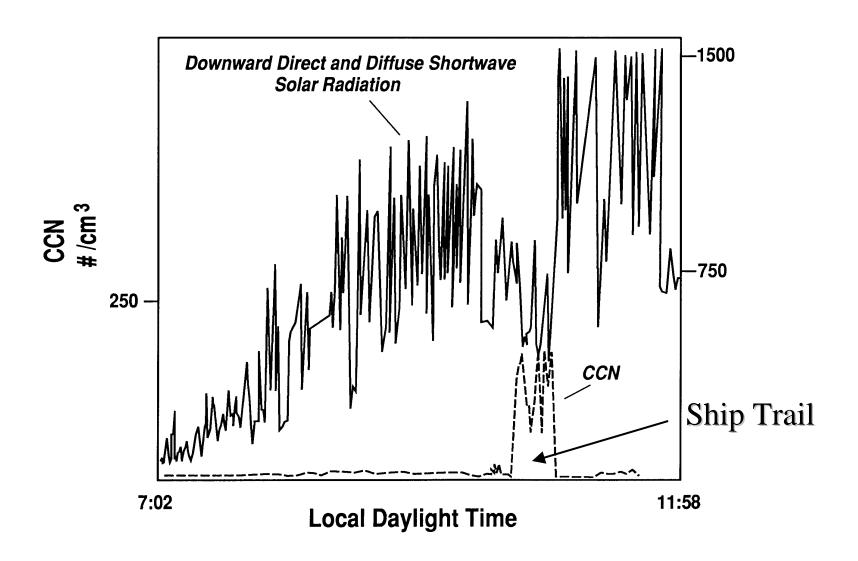
Ship Trail Clouds Observed From GOES Satellite in June 1991 With Research Ship Egabrag

### **MAST Study Region**





### Ship Trail Formed in a Very Low CCN Environment



# The Dichotomy

- Island cloud trails seem to be explained by boundary layer cloud dynamic effects.
- Ship trail clouds are usually explained as a result of ship smoke aerosol (indirect aerosol cloud effect).

Problem: ocean clouds are relatively starved for both aerosol [cloud condensation nuclei] and turbulence.

### Conclusions

- 10 years of ship trail cloud studies indicate both aerosol and dynamic effects (more work is needed to separate them)
- Island cloud trails seem to be explained by dynamic effects and more research on these effects may prove useful in understanding how boundary layer clouds respond to climate changes
- Large scale subsidence is required for both ship tracks and island trails to persist. This allows these phenomena to be used to better understand large scale atmospheric processes.